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ABSTRACT

Taiwan is trying to become an information society. The government is using various strategies to encourage schools to implement computer technology. In the 1980s, colleges and high schools began using computers. Junior high schools began this process in the mid-1980s. There is a lack of research on the influences of those government policies at the junior high school level. Case studies were conducted on computer implementation in two middle (junior high) schools in Taipei. These studies focused on how national and local policies were actually implemented. Data were collected on the uses of computers, hardware and software, curriculum, personnel training, and personnel attitudes toward the implementation. Methods of collecting data included interviews, field observation, document analysis, and questionnaires. Persons interviewed were people involved in the implementation process, including government officials, school teachers, staff members, and school administrators. Major findings were as follows: both schools applied computers mostly in administration rather than instruction; both schools experienced difficulties in coordinating the complexities of technology implementation; one school strictly followed the government policy and received abundant resources and support from the government, and relatively few school personnel were actively involved; the other school acted more autonomously in implementing computers its own way, comparatively more school personnel were involved actively, and this school advanced further in technology growth. (Contains 53 references.) (Author/JLB)

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The Dynamism and Flexibility of Computer Technology Implementation in the Middle Schools in a Centralized Educational System

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Paper presented at 1994 Annual Conference of the American Educational Research Association, New Orleans, April 5, 1994

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The Dynamism and Flexibility of Computer Technology Implementation in the Middle Schools in a Centralized Educational System

ABSTRACT

Taiwan is trying to become an information society. The government is using various strategies to encourage schools to implement computer technology. In the 1980's, first colleges and then high schools began using computers. Following that, junior high schools began this process in the mid-1980's. There is a lack of research on the influences of those government policies at the junior high school level.

Two case studies were conducted on computer implementation in middle (junior high) schools. These studies focused on how national and local polices were actually implemented. Two middle schools in Taipei were selected for in-depth study. Data were collected from relevant individuals on the uses of computers, hardware and software, curriculum, personnel training and personnel attitudes toward the implementation.

The methods used for collecting data included interviews, field observation, document analysis and questionnaires. The persons interviewed were people involved in the implementation process, including government officials, school teachers, staff members, and school administrators.

The major findings were as follows:

Both schools applied computers mostly in administration rather than in instruction. Both schools encountered problems integrating computers into the existing curriculum. Both schools experienced difficulties in coordinating the complexities of technology implementation. One school strictly followed the government policy and received abundant resources and support from the government. Relatively few school personnel were actively involved. The other school acted more autonomously in implementing computers its own way. Comparatively more school personnel were involved actively. Most important, this school advanced further in its technology growth.

INTRODUCTION TO THE PROBLEM

The computer industry in Taiwan has grown rapidly in recent years. "Taiwan's information industry is up and running toward new heights after a decade of rapid development. The island produced US$7.99 billion worth of computer hardware in 1992 to rank sixth in the world" (The Free China Journal, June 4, 1992). The central government is promoting an information society by using various strategies to encourage computer literacy and the implementation of computer technology in administration and instruction in schools (Li, 1984; Yu, 1984). Under the government policy, the Ministry of Education has launched numerous national plans and projects which deal with administration computerization, computer assisted instruction and computer education (Wu, 1987).

In the 1980's, first colleges and then senior high schools began using computers (Yu, 1984, Lin, 1984). Following that, junior high schools (middle schools) began this process in the mid-1980's. By 1987, many plans and projects based on the policies had begun to reach the junior high school level (Ministry of Education, 1987). For example, a new national standard curriculum for junior high schools, which integrated computers into several subjects, was implemented in 1986. A 6-year plan for Computer-Assisted Instruction (CAI) in the schools in Taiwan was instituted in 1986 as a joint project of the Ministry of Education, the National Science Council and the Provincial Government. The goals of the plan emphasized the implementation of CAI, training teachers, developing CAI and encouraging its use in schools (Alessi and Shih, 1988; Mau, 1990). In addition, the Ministry of Education initiated a project in 1986 to establish computer classrooms in every junior high school in Taiwan (MOE, 1989).

Since the educational system in Taiwan is very centralized, any decision made by the educational policy-makers at the higher educational administrative level is supposed to be fully executed at the lower level. It is because of the centralized system that the Ministry of Education (MOE) is able to control and regulate schools with various standards, in terms of curriculum, textbooks, facilities, and personnel. Most important, the MOE was able to allocate a significant portion of the budget to support computer implementation within a very short period of time. By 1987, all of the junior high schools had received a certain amount of computer hardware (Ministry of Education, 1988). By the summer of 1988, over 800 school teachers had been trained in teacher in-service

workshops on CAI (Yu, 1988) and over 200 CAI courseware units had been developed (Alessi and Shih, 1988).

However, in spite of considerable government expenditure in support of the implementation of computers in schools, research has shown that there is some discrepancy between the government's expectations and the actual operation of the governmental plan at the school level (Wu, 1988). Much of the computer hardware has not been used at all, and the computer software has not been incorporated into subject matter instruction and learning (Bureau of Education & Information and Education, 1991). Some subjects which were supposed to incorporate computers in the standard curriculum were not implemented in schools (BOE & Information and Education, 1991). In many schools, computer classrooms were not being used and the doors were locked most of the time (Information and Education & III, 1991). An official of the Taipei City Bureau of Education commented that many individual schools typically adopt administrative computerization faster than the pace of the educational authority (BOE & Information and Education, 1991).

What makes it possible for these problems to exist? First, the problems might arise from educational authorities' unsystematic planning for curriculum development, teacher training, hardware availability and software development. Second, there could be a serious lack of knowledge of the effects of the plans and projects initiated by the national and local policy among the institutions at the lowest level, the junior high school. Third, because of the increasing autonomy they have, individual schools may not exactly follow the authorities' policy. Since the society has undergone drastic changes in recent years, so to has the centralized system changed in many respects. Unlike a few years ago, the junior high schools now have more autonomy to use their own strategies and methods to adopt governmental policies. Individual schools are playing a more active role in the implementation of computer technology, including CAI, computer education and administrative computerization. The extent to which the top-down decision-making process has really been implemented successfully, or at all, is a valid question.

In short, there is a lack of research investigating the influences of those policies and plans on the implementation of computers at the junior high school level. Knowledge about the efforts and actions dealing with the computer technology implementation in individual schools is also sparse.

Therefore, the ultimate goal of this study was to investigate how computers were implemented in junior high schools in Taiwan. In this study, the researcher examined how the policies and plans made by the top

administrative level influenced two junior high schools at the bottom level. The researcher attempted to discover and describe how the junior high schools developed their own strategies to fill the gap between policy from the top and implementation at the bottom in the schools during computer implementation and diffusion.

These efforts were made in order to develop a better understanding of why the government's plans for computer implementation and the actual execution of those plans at the school level appear to be inconsistent, and why many individual schools apparently do not follow the computer implementation pace expected by the educational authorities. These efforts were also made to further the research on the influences of governmental policies and plans on the implementation of computers at the junior high school level, and to enrich the knowledge base concerning computer technology implementation in individual schools.

REVIEW OF RELATED RESEARCH

This section reviews the previous research about computer applications in the schools of Taiwan in terms of computer availability, usage, technical resources, attitudes, and difficulties. Since the implementation of computers in Taiwan's schools has been going on for only about 10 years under the national policy (Ministry of Education, 1991) and the research context was limited to the junior high school level, empirical studies in Chinese or English related to the use of computers in Taiwan's schools are few in number in both English and Chinese journals.

In searching English research literature, little was found relevant to computer use in Taiwan's schools. For example, in the Dissertation Abstracts Ondisk database from 1982 to 1992, 110 dissertations are found under the category of "computer" and "Taiwan". Only 9 are related to the field of education and the use of computers in schools. Among these nine dissertations, only two focus on the junior high level: Tuan (1991) conducted a survey study to determine the content for a computer literacy curriculum at the junior high school level; Shia (1990) conducted a survey on the parental expectations of curriculum outcomes for computer education in Taiwan's secondary schools.

In the ERIC database from 1982 to 1992, there are 21 articles or papers found under the key words of "computers" and "Taiwan" (or the Republic of China). Only five of them dealt with the use of computers in Taiwan's schools. Two papers investigated computer use at the vocational senior high school level. The other

two articles describe the development of CAI in Taiwan in general: Alessi and Shih (1989) described current government projects and expenditures that promote the growth of CAI in Taiwan. Wu (1987) discussed the difficulties in developing CAI in Taiwan.

In a thorough search of research literature written in Chinese, only a few educational journals carried articles related to the use of computers in schools. Most of the articles dealing with computer implementation in junior high schools are not research articles but records of colloquia, symposia minutes and introduction to government policies. For example, in the literature about CAI, according to the Collection of Literature of Computer Assisted Instruction in the Republic of China (Chen, 1991), only seventeen articles, among sixty-eight articles, related to the level of compulsory education, studied the junior high level. Most articles discussed CAI use in some subject-matters. Two studies described relations between computers and students' attitudes and achievement. The rest were general reports of meetings, colloquia and personal opinions.

Previous Research on Computer Usage in Taiwan's Schools

Computer Availability

In Taiwan, five survey studies have investigated computer availability in junior high school. According to a survey study on junior high school teachers, only about 30% of them clearly indicated that there was more than one computer in their schools (Ni, 1987). In a nationwide survey conducted by Wu in 1988, it was found that 42.4% of junior high schools possessed computers. On average, there were only 5.48 computers in each school (Wu, 1988). In 1989, 28.4% of the junior high schools operated one computer lab (Li, 1989) and 25.3% of the junior high schools were planning to set up computer labs. Almost half of all junior high schools had no plans to establish a computer lab at all (46.3%). In the same study, Li found that the availability of computer labs in schools was significantly correlated with the locations of schools and the school size. The computer lab availability for the schools located in cities was higher than schools in rural areas. In 1990, another national survey undertaken by the National Institute of Educational Materials showed that 55.6% of Taiwan's junior high schools operated one computer lab and 40.2% of the schools still had no computer lab. The average number of computers for instruction in each school was 8.34 (National Institute of Educational Materials, 1990).

In general, the difference between current and ideal numbers of computers and network equipment in secondary schools was significant. The number of

microcomputers for junior high schools in Taiwan seems insufficient to meet the needs of instruction (Yang, 1991; Alessi & Shih, 1989).

Implementation

Liang (1988) investigated computer literacy issues in senior high schools and found that there are six major implementation issues associated with the introduction of the literacy program: teacher training, management and maintenance, program objectives, hardware resources, acquisition planning and student access. Among the six issues, he found that 'teacher training', and 'management and maintenance' were two of the most important issues in all schools. In the same study, he also discovered that the computer literacy program for both teacher training and student learning were treated as an isolated subject rather than as an integrated program of computer studies.

Tuan (1990) surveyed opinions of computer experts, computer education experts and school teachers concerning the content of the computer literacy curriculum at the junior high school level and appropriate strategies for implementing the curriculum plan. He found the content areas overlapped among the three groups and there were no significant differences among most of the three groups' choices of implementation methods.

Uses of Computer

Computers are used for both administration and instruction in Taiwan's schools. According to Wu (1988), 76.09% of junior high schools owning computers used computers for administration, while 30.98% of schools used computers for instruction. According to Li (1989), 45.9% of schools used computers for both administration and instruction, 21.6% of schools for administration only and 32.4% of schools for instruction only. No significant correlation was found between the uses of computers and school location.

Spatial Arrangement

The spatial arrangement of computers in schools is a key factor of implementation. Ni (1987) found that most computers in Taiwan's junior high schools are located in the Office of Instructional Affairs and in their computer labs. The findings are consistent with a national survey conducted by Wu (1988), in which he found that over half of junior high schools put computers in the Office of Instructional Affairs and only 10% of the schools had installed computers in computer labs.

Attitudes

A survey study by Yin (1989) found most the principals and teachers in Taiwan have very positive attitudes toward computers. Similar results found by Wu (1988) confirm that over 80 percent of Taiwan's school teachers and administrators consider it an imperative to implement computers in all domains of application in schools. A survey study by Wei (1992) concludes that "Most of Taiwan's senior high school teachers' perceptions of computers were generally positive and supportive" (p. 112). Ni (1987) also found that most junior high teachers hold favorable attitudes about using computers for instruction and administrative support. Nevertheless, Ni (1987) concludes that teachers do not really understand the current usage of computers, because 'software package operation' and 'word processing' are not selected as priorities" (p. 316). The same research also unveils that teachers of natural sciences, mathematics and industrial arts have more experiences and background with computers than teachers of Chinese, music and fine arts.

Difficulties and Problems

Teacher training is the key issue concerning obstacles in implementation of computers in schools. Wu (1988) found that, on average, there were 3.27 computer teachers in each junior high school and most of them had received less than 6 credit hours of computer training. Such short periods of training inhibit successful implementation. First, the computer teacher training program and the demands of computer teaching in schools are not matched in terms of course content and instructional methods. Second, the preparation needs of computer teachers are not met in terms of credit hour requirement thus rendering an inadequate and poorly trained population of teachers (Wu, 1989).

The content of computer education is also a problem. Wu (1989) points out that there are not many differences in the content of computer education among different educational levels. For example, BASIC language is taught repeatedly from the elementary to the senior high level (Wu, 1989; BOE, 1991).

Several main inhibiting factors for instructional computer uses are indicated by Wu (1987), including the lack of computer hardware specially designed for Chinese CAI, a shortage of research manpower, and the lack of a national evaluation system for CAI courseware. In addition, Alessi and Shih (1989) point out that research and evaluation of computer instruction has been minimal and instructional methodologies were few and inadequate.

Overall, the lack of computer facilities, lack of instructional software, school teachers' low rate of computer literacy and lack of experience of using

computers are considered the primary problems for implementing computer technology in junior high schools (MOE Computer Center, 1988). However, the greatest obstacles to implementing computer education is the lack of financial support and the pressure of the senior high schools' entrance examinations. All of these factors do not encourage the use of computers (MOE Computer Center, 1988)

In general, the current problems of computer innovation and diffusion can be summarized as inadequate teacher preparation, poor curriculum design, poverty in research, inadequate hardware and software availability, lack of funding and the traditional attitudes toward the entrance examination.

In summary, the evidence shows that computer availability in Taiwan's schools has increased significantly in recent years, but is still inadequate for efficient instruction. Although school personnel hold positive attitudes toward using computers in schools, many problems and difficulties still persist due to lack of qualified computer teachers, poor curriculum design, lack of funding and inadequate computer availability.

METHODOLOGY

Research Questions

The research questions, which were based on the literature review and the researcher's interest, directed the investigation and determined the methods used for data collection and analysis.

Computer implementation in schools deals with many issues which include, but are not limited to, governmental policy, program objectives, curriculum, resources, personnel training and management. However, the researcher has prioritized the research questions in order to establish the research focus for data collection. To meet the purposes of the present study, the researcher has focused on the following questions:

1. How do the government policies, plans and programs influence the target junior high schools and to what extent are these policies implemented

2. What is the current status of computer usage in the case-study schools?

3. How does the computer implementation process influence the people, including teachers, administrators, and staff, in the target schools, in terms of their perspectives, attitudes and practices?

4. Do the case study schools initiate their own policies and strategies about implementing computer technology?

Research Approach

A qualitative methodology was used to conduct this study in the case study format. The methodology was chosen primarily based on the goal and research questions. The goal of this study is to investigate the process of implementing computer technology in two case study schools in Taiwan. Computer implementation is usually a complex process influenced by many factors in the real world. More specifically, computer implementation deals with innovation, diffusion and planned change and requires identification of problems and needs, negotiations, decision-making and policy execution. Each of these activities involves complicated human interactions. The process of adoption is not simply several outcomes derived from a plan. Implementation is a process rather than a product. Therefore, a descriptive research methodology may better enhance the understanding of the implementation process than a quantitative approach. In other words, a case study can provide specific insight into the process of computer technology implementation in educational institutions.

The Selection of the Target Schools

In order to gain in-depth understanding of computer technology implementation, the researcher focused his investigation on two schools. The selection of the case study schools was primarily based on the characteristics of computer implementation and the accessibility of the schools by the researcher.

The first target school, Tai-Nan (pseudonym) junior high school, is an average-sized school among all 71 public junior high schools in Taipei. This school has implemented computer technology for over five years. The school was chosen by the researcher because of its independent planning efforts for computer implementation, which is rare in a centralized educational system, such as Taiwan's. The second case study school, Pin-Tung (pseudonym) junior high school, is one of the model schools for computer implementation chosen by the Taipei City Bureau of Education (BOE). As one of the most famous schools in Taipei for computer implementation, the school is in charge of many computer workshops and training, as well as computer projects, for the BOE.

Data Collection

According to the structure of education administration in Taiwan, data were collected from three administrative levels--the top level (the national level or central government level), the middle level (local level or city level) and the lower level (junior high schools).

The data collection process went through two stages: the initial stage and case study stage. The initial stage was from June to August of 1992. The researcher focused on collecting general information about the government policies, establishing connections with relevant people and institutions and gaining commitment from the two target schools. The case study stage lasted from March to May of 1993. At this time, the researcher focused on interviewing school personnel and observing computer sites in the target schools.

The Initial Stage

Data collection was initiated during the summer of 1992. The researcher stayed in Taipei from June to August and began to collect information relevant to computer implementation at the junior high school level. Information was collected through three approaches: collecting information in the libraries, visiting relevant government institutions for official documents and interviews, and visiting several local junior high schools for general understanding of computer applications.

The researcher visited several major educational institutions: the Division of Compulsory Education, the Ministry of Education (MOE); the MOE Computer Center; the MOE Technology Consultant Office, the Division of Science Education Development, the National Science Council; the Division of Education and Training, the Institute for Information Industry (III); the Information and Computer Magazine Publisher Co., III; the Second Division (for junior high school level) of the Taipei City Bureau of Education (BOE); and the National Taiwan Normal University. The researcher used various ways to establish his connections with these institutions, and hence many unpublished and non-circulated documents were provided by them upon the researcher's request. The researcher also conducted over twenty interviews or informal discussions with the primary administrators in these institutions.

In the meantime, the researcher gradually focused on two target schools and tried to establish connections with them. The possibility of conducting case studies in the two target schools was enabled by frequent contacts between the researcher and the schools' personnel.

The Case-study Stage

In late March of 1993, the researcher went back to Taipei again and stayed there for two months to collect data. During this time, the researcher focused his investigation on the two target schools.

To gain access to the schools, the researcher first met with the school principal and directors in each school to obtain their agreement. The researcher was allowed to visit their campuses and offices any time during their regular working schedule. The researcher also gained access to the computer classrooms to observe their computer courses and training workshops.

The researcher spent about 20 hours per week in each school. Usually, the researcher stayed in one school a whole morning or afternoon per visit. When the researcher visited the schools, he conducted in-depth interviews, observed computer sites, took field notes and conducted informal discussions with school personnel.

Instrument

In this study, the researcher himself was the primary instrument for data collection and analysis. The researcher was the interviewer, observer, document collector, data analyst and the questionnaire designer.

The researcher's past working experience in junior high schools played a beneficial role in the investigation process. Based on this experience, the researcher had an understanding of the administrative and political structure in the schools and was able to easily establish connections with school personnel, to deal with political considerations, to ask the right questions of the right people, to lead information toward fruitful directions and to judge the degree of validity of the information gathered from interviews. In addition to the researcher, the other instrument for this study was a single-paged questionnaire developed by the researcher. The questionnaire was used to collect data which was not easily obtained through interviews and observations.

Methods of Data Collection

Document Review and Analysis

Document review analysis is an essential method used in the initial stage in naturalistic inquiry. In this study, document analysis was used primarily for the investigation of policies and plans at the national and the local levels. By reviewing documents, the researcher was able to form the research framework and direct the focus of data collection. These documents include:

a. Articles from educational computing journals and books in Taiwan.

b. Official records, minutes of meetings and proposals of national policies, plans and projects.

c. Official records and proposals of policies and plans at the local level.

d. Textbooks and relevant instructional materials for the junior high schools.

e. Official records and archive documents kept in the target schools.

Some data were collected from public or university libraries. Most data were requested by the researcher personally from certain institutions. Triangulation methods were used to check the accuracy of the content of documents.

In-depth Interviews and informal interview

In-depth interviews were conducted to obtain detailed information from key persons who were deeply involved in the development of national plans and projects. However, this method was used primarily in the target schools. The interviewees were school personnel who were the promoters of computers in their own schools, or those who used computers frequently for instruction and administration. The interviews were either conducted face-to-face or over the telephone. Most interviews took place in the interviewees' offices. Usually, each interview lasted from thirty minutes to one hour. The researcher took notes during the interviews. Audio taping was also used in some interviews by the researcher with the interviewees' permission. The methods of triangulation and member check were employed to ensure the validity of the information.

In addition to these in-depth interviews, the researcher also carried on many informal interviews with relevant people, including school administrators, teachers and students when conducting this study, especially during field observations. The purpose of the informal interview were for data confirmation and data augmentation. The informal interview locations were not restricted to the computer sites, but often took place in the teachers' offices or off the campus. Many informal interviews were conducted by chance without prior appointment.

Interviewees (Participants)

In this study, the interviewees were governmental officials and administrators from several institutions, and teachers, administrators, and staff members in the two target schools. The researcher conducted in-depth interviews or informal interviews with about twenty participants in the government institutions, including the Ministry of Education, National Science Council, Institute for Information Industry and the Bureau of Education of Taipei City Government. Additionally, several college professors who participated in the development of national policies and plans were interviewed.

In the first target school, Tai-Nan, the researcher interviewed more than 30 school personnel, including the principal, three office directors, seven coordinators, two computer teachers, two to three staff members in each office and over fifteen teachers. In the second target school, Pin-Tung, the number of participants for interviews was about 15, less than that in Tai-Nan because fewer personnel were involved in the computer implementation. The participants were the principal, an office director, two coordinators, several staff members and teachers and several members from the BOE computer team. Many of the participants were interviewed more than twice for different questions. Since both schools have not yet applied computer curriculum and very few students were involved in the use of computers, the researcher did not conducted in-depth interview with students.

Field Observation

Observation is the best technique to use when an activity, event or situation can be observed first hand (Merriam, 1990). Since the researcher was interested in knowing how computers were used and located in the schools, observation served the research purposes well.

In this study, field observations were used to obtain first-hand information at the school level. All observations took place on the case study school campus. The researcher observed the different computer sites of the schools, such as Student Supervision offices, Instructional Affairs offices, and Counseling offices and so on. The computer classrooms in both schools were the main targets for observation. In addition, the researcher participated in several meetings and courses related to the usage of computers. Merriam (1990) suggests the strategy of repeated observation to ensure internal validity. The researcher observed each computer site more than ten times during the period of data collection. The researcher also used a video camera in order to help refresh his recollection of those observations for data analysis and report writing.

Questionnaire Survey

Since the researcher could not interview all teachers and administrators in the case-study schools, a single-page questionnaire was used for collecting additional relevant data.

The questionnaire was used to:

a. find out how the respondents use computers in their work;

b. find out the respondents' degree of computer training background;

c. solicit their opinions of and attitudes toward the implementation of computers in their schools.

The questionnaire contained two types of items: demographic and opinion. The demographic items were used to survey the personnel's positions, training backgrounds and computer uses. The opinion items were open-end style and intended to obtain participants' general opinions toward computer implementation in their schools and the obstacles they perceived in the implementation process.

Respondents for the questionnaire survey were all administrators, teachers and staff members in the case study schools. In Tai-Nan, 150 questionnaires were distributed and 89 were returned, including 13 administrators, 64 teachers and 12 staff members, for a return rate of 59.3%. In Pin-Tung, 110 copies were distributed and 59 were returned, including 7 from administrators, 47 from teachers and 3 from staff members. The return rate here was 53.6%.

INTRODUCTION TO THE CONTEXT

Taiwan's production of computer hardware and software has been mushrooming since the 1980's. In 1992, Taiwan produced US$7.99 billion worth of computer hardware in 1992 and ranks as the sixth highest producer in the world. The development of the computer industry is actually a government strategy to promote Taiwan's development as an information society. Education also plays a role in facilitating the promotion of an information society. The Ministry of Education has initiated a variety of computer relevant plans and projects, dealing with curriculum establishment, teacher training, administrative use of computers and CAI development. In order to cooperate with MOE's policy, the Taipei BOE also has developed its computer diffusion policies, including computer facilities dissemination, teacher training and software grading system development.

Taiwan's Educational System

The educational system in Taiwan is highly centralized; the constitution mandates a certain percentage of the national annual budget be allocated for education. It sets national education goals for different educational levels. It establishes a national standardized curriculum. National policies affect each level of the educational bureaucracy all the way down to the local schools. The Ministry of Education (MOE), the highest educational administrative institute in

the country, is responsible for developing national educational policies, allocating the national educational budget, handling national educational affairs, regulating and developing a standard national curriculum and a variety of other educational regulations. In Taipei, the Bureau of Education (BOE) is in charge of educational affairs for its administrative districts. It also regulates the municipal schools and allocates the educational budget.

Junior High Schools (Middle Schools)

Junior high schools (middle schools) in Taiwan are equivalent to the 7th to 9th grades in the educational system in the U.S. Junior high school has been compulsory and free for all elementary graduates since 1968.

The junior high school level is a component of the centralized educational system in Taiwan. All schools follow the standardized regulations in the curriculum, textbooks, school schedule, facilities and administrative structure.

The school curriculum in all junior high schools is the same, based on the National Standard Curriculum for Junior High Schools, which not only sets the educational goals and objectives, but also regulates course subjects and their implementation, as well as the time spent on teaching each subject. All junior high schools in Taiwan use the same standard textbooks for most subject matters.

In reality, the senior high school entrance examination drives the education plans in junior high schools, in terms of instruction, curriculum execution and measurement and evaluation, as well as the parents' and teachers' values of and attitudes toward schooling.

The Computer Implementation for Junior High Schools at the National Level

The national policy for the promotion of an information society was initiated by the Executive Yuen (the Cabinet). Based on the policy, the MOE developed a plan for the implementation of computer education at all educational levels. According to an official document about the plan, there are several features of the policy relevant to the junior high level:

1. Goal: Have students understand basic knowledge about computers, as well as computer applications.

2. Facility: Every middle school in the nation maintains at least one computer classroom.

3. Teachers computer literacy: Over 30% school teachers receive computer literacy training.

4. Curriculum: Develop a holistic computer curriculum from elementary to high school level.

5. Budget: Central government and city government equally share the budget. Total amount will be NT$650,700,000 (about US$24,500,000).

Some governmental or semi-governmental institutes were commissioned to execute computer-relevant projects, including the Institute for Information Industry (III) for computer teacher in-service training, the MOE Computer Center for CAI courseware development, the National Science Council for CAI research, four universities for CAI designer training and the BOE for computer hardware dissemination and computer classroom establishment.

The major computer plans relevant to the junior high school level are the integration of computers into standardized curriculum, computer teacher training and computer-assisted instructional development.

A new standard curriculum was established in 1985. Computers were not considered to be an independent subject-matter but, instead, were integrated into some subjects, including Industrial Arts (a subject for male students), Applied Mathematics (an elective vocational subject) and extracurricular activities. However, it is a milestone that computer literacy was formally recognized as a necessary type of knowledge for all students.

A teacher training program was established in 1985 in order to train school teachers at all educational levels for computer instruction and to train school administrators in the use of computers. The program is executed by the Institute for Information Industry (III). By 1993, about 450 junior high school teachers received formal computer teacher certification.

The plan for Computer-Assisted Instruction development included the following aspects: CAI courseware development, CAI teacher training and CAI workshops. From 1986-1991, 6,360 school teachers were trained, including 1,760 teachers from junior high schools. By 1992, over 200 courseware units had been developed and distributed to the junior high schools.

The Local Context of Computer Implementation

In order to meet the MOE policy requirements, the Bureau of Education of the Taipei City Government set up diffusion strategies for implementing computers in schools and initiated several projects/plans at the junior high school level. Those diffusion strategies included commissioning schools with computer projects. Some schools were chosen to be the key schools which have top priority in personnel training and computer facilities. They also served as model schools and perform change agency functions by holding computer workshops and training for the other schools. A computer team was also

established by the BOE to execute the computer plans and develop software system for all junior high schools in Taipei.

Various projects and activities for computer implementation were sponsored by the BOE. The projects most relevant to junior high schools include the establishment of a computer classroom in each junior high school, the development of a computer software system for administrative use and the presentation of local in-service training programs for school teachers. In 1988, the MOE, cooperating with the BOE, developed a plan to establish computer classrooms in every junior high school in an attempt to match the facility standard for the new curriculum and the needs of instruction. The hardware that was disseminated to each junior high school included 25 XT PCs, four printers and necessary accessories.

According to a survey of 71 junior high schools in Taipei done by the BOE Computer Team in the spring of 1993, there were 6.07 PCs and 6.75 printers for administrative use in each school. Most schools acquired funding other than schools' official budget to purchase their own computer hardware. At this time, only three schools had installed a computer network. Most schools had some sort of computer systems, such as an enrollment and registration management system, a scoring management system or a school property management system. Only eleven schools owned library management systems or a curriculum management system. Over 80% of schools used word processors, 76% of schools used Anti-Virus software and about 40% of schools used spreadsheets and databases.

THE FIRST CASE STUDY SCHOOL: TAI-NAN JUNIOR HIGH SCHOOL

Background

Taipei Municipal Tai-Nan High School (pseudonym) is located in a suburban area in northeastern Taipei. Founded in 1981, it has a majority of young teachers and personnel. The number of personnel in this school is about 165, including about 25 administrators, 110 teachers and 30 staff. The student population of this school has remained around 2,600 in recent years. Like most of the other junior high schools in Taipei, its administrative structure and curriculum are regulated by the Taipei Bureau of Education (BOE).

The situation of Computer Implementation at Tai-Nan

Computers were implemented in this school when a private computer company offered the hardware and initiated a computer course program in 1987. Although the program was discontinued due to its business orientation, the school's computer implementation was soon resumed with hardware and facilities support from the BOE a year later. In 1988, 25 XT IBM compatible PCs were delivered to this school from the BOE to establish a computer classroom for instructional use. The BOE's support in establishing this computer classroom raised the school personnel's awareness of computer potential of computer application, and encouraged them to expand the hardware for administration. In 1993, there were 9 PCs and 7 printers for administrative use. Most of the main offices have computer equipment, but not the teacher offices and the school library. It is worth noting that all the computers are IBM compatible without exception.

Not only did Tai-Nan take great efforts to expand its computer hardware, it also actively acquired software through several venues, such as the authorities (the MOE and the BOE) and the market place. It was also provided with software developed by a school teacher, and contributed by school personnel. In addition, Tai-Nan established its own local computer network for administration one year before the BOE initiated a network project. This computer network has increased the administrative efficiency in terms of student data sharing and acquisition although it is slow in processing data.

According to the within-school survey done by the researcher, nearly two-thirds of the school personnel have received computer literacy training from various governmental and private institutes, including in-service training in normal universities. The school also has its own teacher development program for enhancing the teachers' computer literacy. During the program's 2 years development, about a quarter of school personnel were trained. It was unfortunately discontinued due to the difficulty in arranging a proper schedule for those who were interested in it. Although it seems that the school personnel have had many opportunities to receive computer training, most teachers do not apply computers in their teaching. According to the Curriculum Standard, computer literacy is not an independent subject, but integrated with two subjects--Industrial Arts and Applied Mathematics. However, Applied Mathematics has never been offered by the school since no students have registered this course. The school also offers a computer study course as one of the extracurricular activities, which is provided only one hour per week for 40 students, a small percentage of 2,600 total students. The pressure of the senior high school

entrance examination further discourages the teachers from applying computers in their instruction. Therefore, even though the school has installed the essential equipment in the computer classroom, it has not been fully utilized in the past five years. Computer-assisted instruction is not adopted by school teachers. Recently, a newly developed policy by the BOE requires all teachers of grade 7 to input students' scores into the computer database system. This policy has been adopted and implemented in this school.

The school allocated a considerable amount of money (over US$20,000) on administrative computerization, including administrative software system development and network establishment. Most of the funding came from non-governmental sources, such as after-class tuition fees, income from the school shop and special donations from students' parents.

In general, computers have been widely used in administration, but not for instruction yet.

Policy Aspects at Tai-Nan

During the implementation process, Tai-Nan not only executed the authority's policies, but also developed its own since it did not have a close relationship to the authority--BOE. Such a relationship has made the school implement computer technology based on its own needs, rather than on the authority's recommendations. Even so, the authority's policies still have had some impact on the school. Among the various policies, the computerization of administration and extended compulsory education program for junior high students have had the most influence on the school. By contrast, the computer-assisted instruction policy has not been taken into serious consideration as it fails to meet the needs of the school teachers. Although the application of computer scoring has saved a lot of time for the staff in the Instructional Affairs Office, the school teachers did not benefit from it--for a decrease in the workload of the administrators in this office requires the teachers to do extra work on scores input.

When the school developed its own policies for computer implementation, the administrators, especially the principal and the directors of the various offices, took the leadership in decision making. However, such a decision making process relies heavily on the computer teacher's expertise. The administrators followed the computer teacher's recommendations and suggestions on computer implementation and played an active role in diffusing these ideas to school personnel. Indeed, the diffusion process takes multiple forms and undergoes several paths: from the computer teacher to the

administrators, from the administrators to staff and teachers, and from one office to another.

Human Aspects at Tai-Nan

In carrying out computer implementation, human factors, rather than hardware and facilities, are the primary determinants of the direction and quality of the implementation. Personal involvement indicates the way and the degree to which computers are implemented. Personal perspectives and attitudes are also contributing human factors. However, personal involvement often has something to do with the person's computer background, commitment to and enthusiasm for computers and the advantages one obtains. Overall, administrators tend to hold more positive attitudes toward computers than teachers do; younger teachers are more enthusiastic to learn about computers than older teachers. Nevertheless, despite the computer training they received, many school personnel still do not have adequate knowledge of particular computer uses, such as virus protection, data backup and floppy disk protection. This, as well as the turnover of the school teachers, has influenced the quality of computer implementation in this school.

Diffusion Aspects at Tai-Nan

Among the many human factors, some have worked to facilitate the implementation, such as personnel's positive attitudes toward the computer, individual efforts and support from the administrator are contributing factors. However, problems of compatibility, the unpredictability of computer development, and difficulty in computer maintenance have negatively affected the quality of computer implementation to some extent. Although computer application for administration is quite successful, there are several barriers for using computers for instruction. The major obstacles to integrating computers into instruction are fear that computers would break the normal pattern of instruction, lack of technical support staff for the computer classroom, teachers' lack of capability for class management in computer classroom and the pressure of the entrance examination.

The implementation of computer technology has exerted both positive and negative influences on the school. While administrative performance has been much improved, the relationship between the administrators and teachers is strained due to the conflicts of work load. Such a change in human relationship goes with dissatisfaction toward computer implementation. In

addition, complaints about extra budget expenditures and competitive training opportunities are also negative products of such implementation.

THE SECOND CASE STUDY SCHOOL: PIN-TUNG JUNIOR HIGH SCHOOL

Background

Pin-Tung (pseudonym) is a typical junior high school in Taipei. It was established in 1969, one year after compulsory education in Taiwan was extended from 6 years to 9 years, to accommodate the increasing number of junior high students. While the campus is relatively small compared to most junior high schools in Taipei, its facilities are above standard. In 1993, there were 135 school personnel, including about 20 administrators, 90 teachers, and 25 staff members. The number of students has been around 2,000 in recent years. Although it differs from many other schools in its co-education policy and in providing adult education, the authority, the BOE, and the national educational standards strictly regulate its facilities, administration, personnel and student registration.

Computer Implementation as Evolution

Pin-Tung's computer implementation started in 1989. With the assistance of an excellent computer teacher and abundant financial resources, the school successfully established a computer classroom by itself, and integrated computer technology into the curriculum in the first few years. Based on the success, the school was selected by the BOE (the Taipei Bureau of Education) as one of the model schools for computer implementation, taking responsibility for the BOE computer projects. The BOE Computer Team, which was formed to develop the administrative computerization for all schools in Taipei, was located in Pin-Tung and shares the school's computer resources. The relationship between this school and the BOE is hence tightened, making the school closely follow the BOE's policies, which are usually formulated and developed slowly. The BOE computer team's efforts to diffuse computer technology to other schools, however, has stifled computer implementation within the school itself.

Regarding computer applications, the school has used computers more for administration than instruction. Administrative computerization was initiated in this school several years ago. The Office of Instructional Affairs owns an computer lab with several IBM PCs, a laser printer, an color image scanner, and some software systems. While most administrative work in this office has been

computerized in terms of student record keeping, registration and scoring, the other offices still do not own any computers.

Pin-Tung has consistently expanded its computer hardware since computer implementation was launched in this school when a student's parent donated a considerable amount of money to establish a computer classroom. However, this classroom and the other one established under the support of the BOE were not fully utilized because of the rigid curriculum. After the BOE Computer Team took over the classrooms, all computer courses offered to students were terminated since the BOE team began using the classrooms for workshops during weekdays and teacher training programs on the weekends or evenings. But, the classrooms are used more frequently than before even though students do not have access to them. In addition to computer hardware and facilities, Pin-Tung also applied a computer network to instructional management at an early stage, compared to most junior high schools in Taipei. The integration of curriculum with computer and administrative computerization in this school, unfortunately, did not expand with the advancement of the facilities.

The School Authority Relationship

The relationship between Pin-Tung and the authority has been very close since it was selected as one of the key schools for computer implementation. The relationship has influenced computer implementation in this school in several aspects: 1) It follows the authority's pace of computer implementation closely; 2) Its hardware and software supply, as well as personnel training and budget, are regarded as the top priority by the BOE; 3) It is involved in many projects undertaken by the BOE and shares many responsibilities for computer training. The tasks include holding workshops and conferences for the other schools in Taipei, holding the local in-service computer training for school teachers in Taipei and hosting visiting educators from the other countries.

The BOE computer team's location in Pin-Tung also tightens the relationship. Not only was the principal assigned to be the coordinator for the administrative computerization project, but an Industrial Arts teacher in this school also joined this team and became its leader. Although the BOE computer team can offer timely help and consultation to school personnel, it is, however, perceived as a negative factor to the computer implementation in this school. The school is focusing on the external diffusion efforts of the BOE, rather than on the internal computer implementation.

Policy Aspects at Pin-Tung

By closely following the BOE's policy for implementing computer technology, Pin-Tung has not developed its own implementation strategies. It simply uses the software systems and network that the BOE has developed and distributed. It also has joined the experimental compulsory education program sponsored by the BOE, which requires teachers to use computers to store students' scores. Although the number of school personnel who are using computers has increased, the opportunities for students to access the computer has decreased. The computer courses have been interrupted by the BOE computer team, which provides training for the outsiders, rather than the school personnel and students. The close relationship between Pin-Tung and the BOE slowed down the internal development of computer implementation at the school.

Human Aspects at Pin-Tung

There are several human factors that influence the computer implementation at Pin-Tung. They are personal involvement, administrators' support and individuals' efforts. Since computers are accessible and applied only in the Instructional Affairs Office, administrators and staff members in the other offices rarely apply computers to their administrative work. In addition, only a few students have had the opportunity to take computer courses in the past few years due to the rigidity of the curriculum.

However, despite the lack of personal involvement, the administrators' support and several individuals' effort play a critical role in the computer implementation, especially before the BOE computer team took over the two computer classrooms. The principal's and the Instructional Affairs director's support makes possible the extra funding been expended on computer application, and the donations from student parents for computer facilities.

The computer teacher's influence on and contribution to computer implementation was fundamental during the early stage. Pin-Tung was selected as one of the computer model schools largely because of his effort in establishing the computer classroom and providing the computer courses. His computer expertise, commitment and motivation are the real factors that make possible his persisting contribution to the computer implementation.

Diffusion Aspects at Pin-Tung

There are both positive and negative factors for computer implementation at Pin-Tung. The positive factors are: 1) the support of the principal and the

director; 2) the expertise and commitment of the computer teachers; and 3) the abundant funding sources for computer implementation. The negative factors are: 1) the lack of personnel for computer maintenance; 2) the waste of resources; 3) the lack of virus protection; 4) the lack of adequate software; and 5) the impact of the entrance examination on curriculum and instruction.

Generally speaking, computer implementation in this school has gone through two stages in the past few years. During the first stage, Pin-Tung rapidly developed its own computer facilities and curriculum. In the second stage, Pin-Tung played the role of a computer model school and invested most of its human and material resources in the BOE's projects. Pin-Tung's shift from internal development of computer implementation to the diffusion of its computer technology to external sources has had profound impact on the whole school.

DISCUSSION AND COMPARISON

At both Pin-Tung junior high school and Tai-Nan junior high school, policy, people, and the relationship with the authority have been the primary factors influencing the implementation of computers into the schools. Tai-Nan and Pin-Tung follow a similar pattern in their application of computers to the standard curriculum and in the content of their computer courses. In the past five years, neither school followed the standard curriculum which required integrating computers into Industrial Arts and Applied Mathematics. Rather, both schools taught courses based on student interest, i.e., graphics and word processing in Chinese.

Since Pin-Tung was founded much earlier than Tai-Nan, its personnel have been recruited over a period of 23 years rather than 10 years. Thus, the age difference among the school personnel is greater and there are more senior teachers than at Tai-Nan. The age differences have resulted in different attitudes toward the use of computers.

While Pin-Tung introduced its computer hardware in two years, Tai-Nan expanded its hardware facilities gradually in six years. Unlike Tai-Nan which developed its own administrative software system, Pin-Tung uses the one developed by the BOE Computer Team, as many other schools have done. Pin-Tung uses the BOE administrative network with no plans for setting up its own network, while Tai-Nan has purchased its own network. Tai-Nan moved

quickly to develop and establish its own administrative network system. Although Tai-Nan enjoyed the convenience of early computer technology adoption, it may have unnecessarily spent human and non human resources on developing the kind of software and networks that the BOE already planned to implement. Tai-Nan still took efforts to integrate computer courses into its curriculum, while Pin-Tung's computer courses were completely terminated when the BOE computer team took over its computer classrooms. Pin-Tung had more funding for computer implementation than Tai-Nan. Its funding came from several sources: the donations of parents and the income from its computer training and adult education programs. The largest funding came from the donation of the students' parents committee. Tai-Nan's parents' committee prefers social gatherings, while Pin-Tung parents' committee is eager to promote academic activities in the school.

In terms of the human factors, the two schools faced quite different situations. During the first stage of Pin-Tung's computer implementation one teacher had just returned from computer training and was able to immediately apply what he learned to facilitate computer implementation. However, Tai-Nan did not have anyone with computer training for two years until a computer teacher was transferred to the school in 1990.

Comparatively speaking, the implementation process of computer technology was faster in Tai-Nan than in Pin-Tung even though the latter had more resources and funding for hardware and facilities. Policies issued by the BOE involve political maneuvering and so proceed through the official budgeting process at a relatively slow pace. Therefore, by strictly following the BOE's pace, Pin-Tung fell behind Tai-Nan in developing its own policies and strategies to fulfill their own needs. The computer implementation process at Tai-Nan has made steady progress. However, the computer implementation in Pin-Tung was slowed down and even became static after the BOE computer team took over its computer classrooms. Indeed, the difference is a result of its relationship with the central authority--the BOE.

The relationship with the BOE also exerts substantial influence on how computers are implemented. As a model school Pin-Tung has undertaken many computer projects, but for the BOE as an example for other schools. Without being obligated to the BOE, Tai-Nan's computer implementation focuses on computer needs of the school. The disadvantage is that due to its independence of the BOE, Tai-Nan has expended more of its own human and non human resources on developing the kind of software that the BOE issued later. Although the school experienced less pressure from the authorities and enjoyed

more autonomous policy execution, it was not always informed of the latest policies issued by the BOE. Overall, Tai-Nan focuses on implementing computer technology within its own school. On the contrary, Pin-Tung has concentrated on diffusing computer technology to external sources in recent years.

Although there are many differences between the two schools, several aspects of the implementation in both schools follow the trend of computer implementation in Taiwan. Based on Wu's (1988) and Li's (1989) studies, both schools' computer availability and facilities are beyond the average level. Even the more recent studies, such as the one conducted by the National Institute of Educational Materials (1990), confirms this fact. However, the number of microcomputers for the two schools is still insufficient to meet the needs of instruction, which has been raised in the previous studies (such as Yang, 1991; Alessi & Shih, 1989).

In addition, this study reveals that computers in both schools are used for administration more than instruction, as illustrated in Wu's (1988) and Li's (1989) studies. Computers are applied mostly for keeping class records, storing, analyzing and reporting student records, contracting grade, generating report cards, and scoring and analyzing tests. This reflects Riedesel and Clements' (1985) contention of the potential applications of computers with regard to students. This study also confirms Patterson's (1983) finding that teachers' motivation, teachers' participation, the effects of school setting and the role of leadership are the four critical factors that shape the quality of implementation. As described earlier, most school personnel in the two schools hold positive attitude toward computer implementation. Many of the previous studies, such as Yin's (1989), Wu's (1988) and Wei's (1992), also had similar finding.

Conjectures Arising from the Two Case Studies

The case studies not only illustrate specific similarities and differences in computer implementation in two schools, but also may reflect more general trends in computer implementation at the junior high level in the Taipei city area. Below are some conjectures arising from the two case studies:

a. The closer a school relates to the authority, the more resources it can obtain, but, it sacrifices the autonomy in developing its own policies and strategies.

b. Under the centralized educational system, the authority will exert more and more influence on the individual schools when it issues more and more policies on computer implementation.

c. Autonomy from BOE policies may result in unsystematic planning of the curriculum and teacher training, as well as duplication of hardware resources and software development.

d. Teachers' lack of expertise may result in unsuccessful integration of computers into the curriculum, in such areas as Applied Mathematics and Industrial Arts.

e. The courses may be designed in such a way that they do not fit into the implementation process. For example, Applied Mathematics is an elective course for which no student enrolled. Under such circumstance, even though the BOE tried to integrate computers into this course, the effort was futile.

f. The senior high school entrance examination exerts great pressure on both teachers and students and discourages teachers from developing or applying instructional programs because teachers would not undertake work that cannot help enhance students' performance on the entrance examination.

g. Teachers may resent having to input scores themselves, when this was previously a job for the administrators and staff.

h. Administrators, rather than teachers, are inclined to apply computers in their work because administrative computerization is an easier task than instructional computerization. Teachers have to learn more than the rudimentary skills required for data recording. Instructional computerization involves course content redesign, which cannot be accomplished through mere computer literacy training.

i. The rapidity of computer development could be a fundamental problem for expanding computer adoption in schools. The rapid change and development of computer technology, both hardware and software, often discourages policy-makers or policy-executors from becoming involved in long-term investment in computer facilities or personnel training. Even computer experts may not be able to accurately predict what might happen in the next few years in the computer market.

Significance of this Study

This study provides administrators and teachers in Taiwan's middle schools with perspectives on and potential insights into the computer implementation process in the following ways:

a. The different and unique situations of computer implementation of the two case-study schools may widen the policy-makers' understanding of how differently the policies issued by the authority may be executed, and hence may enable them to make better plans and policies in the future.

b. The study also provides educational practitioners with detailed information of the computer implementation process. They may learn lessons from the experiences of the two schools, and further improve their own strategies for computer implementation.

c. Since this study uses many historical documents which record the educational practice in the junior high educational context during a certain period of time, it may serve as a valuable document for continuing study on computer implementation at the junior high level.

d. This study could provide valuable information for future research in the field of educational computing since it documents the complicated interplay among policies, implementation processes and people

This study presents a holistic picture--the process and evolution of the computer implementation process--rather than investigating a few variables. Although generalizations are not possible from such a small sample, but conjectures can be made based on insight into and understanding of at least two situations. The study can inform policy-makers and practitioners that computer implementation depends not only on computer technology itself, but also policy, strategies, resources, training, as well as human factors. Systemic consideration of these factors necessary for successful implementation. Therefore, this study may help educational policy-makers and planners to improve their future planning and strategies so as to optimize the quality and practicability of their decisions, and ultimately promote systemic planning of computer implementation.

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